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ABSTRACT

A study of discourse synthesis (readers/writers composing new texts by selecting, organizing, and connecting content from source texts) examined the performance of accomplished and less accomplished readers in the 6th, 8th, and 10th grades on a report-writing task. Over a 3-day period 60 English/language arts students wrote informational reports composed of content they selected from 3 source texts (encyclopedia articles on a single topic) as well as content they added. Text analyses revealed patterns associated with both grade level and reading ability in selecting and connecting content, since the older students and the accomplished readers included larger proportions of intertextually important content from the source texts and provided more connectivity for their readers. Analyses also revealed patterns associated with reading ability in the nature of the text structures that students used to organize clusters of content. Moreover, differences between readers were manifested on measures of task management as well as on text features, with the accomplished readers developing more elaborate written plans and spending more time on the task. The study extended research into writing as well as research into reading by focusing on a hybrid, reading-to-write task that involves both constructive processes. (Five tables of data and 6 figures are included, and 81 references are attached.) (Author/SR)

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Technical Report No. 18

READERS AS WRITERS COMPOSING FROM SOURCES

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Abstract

In *discourse synthesis* readers/writers compose new texts by selecting, organizing, and connecting content from source texts. This study of discourse synthesis examined the performance of accomplished and less accomplished readers in the 6th, 8th, and 10th grades on a report-writing task. Over a three-day period in their English/language arts classes, the 60 students in the study wrote informational reports composed of content they selected from three source texts (encyclopedia articles on a single topic) as well as content they added. Text analyses revealed patterns associated with both grade level and reading ability in selecting and connecting content, since the older students and the accomplished readers included larger proportions of intertextually important content from the source texts and provided more connectivity for their readers. Analyses also revealed patterns associated with reading ability in the nature of the text structures that students used to organize clusters of content. Moreover, differences between readers were manifested on measures of task management as well as on text features, with the accomplished readers developing more elaborate written plans and spending more time on the task. The study extends research into writing as well as research into reading by focusing on a hybrid, reading-to-write task that involves both constructive processes.

READERS AS WRITERS COMPOSING FROM SOURCES

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For the past 15 years or so, reading researchers in the constructivist tradition have been studying discourse comprehension as readers' building of mental representations through their interactions with texts. Constructivism portrays readers as making meaning by integrating content from source texts with previously acquired knowledge in a process that involves the operations of *selecting*, *organizing*, and *connecting*. Readers select content on the basis of some relevance principle, organize the content by applying their knowledge of discourse structures, and connect related ideas by discovering and generating links (for a review of research in the constructivist tradition, see Spivey, 1987). Selecting, organizing, and connecting are also apparent in *discourse synthesis*, a highly constructive act in which readers become writers (Spivey, 1984). In discourse synthesis readers/writers select, organize, and connect content from source texts as they compose their own new texts. On what basis do they make these selections for their syntheses? How do they organize the content they select? How successful are they at transforming the source content into their own connected discourse? These questions guided the study reported here which looked for patterns associated with age/grade level and general reading ability, two factors examined rather extensively in comprehension research. The study was thus informed by constructivist perspectives on *reading to understand* as well as by recent inquiries into *reading to write* (Flower, 1987).

Reading to Understand a Text

Because readers cannot, or may not want to, retain all of the information from a text, they *select* from the available content. Reading is almost always an abstractive, reductive process in which a subset of the source material is integrated. Readers, either tacitly or consciously depending on the task demands, make selections on the basis of some relevance principle, some criterion of importance. This criterion, according to van Dijk (1979), may be *textual*, how high the content is placed in the text structure (cf. Meyer, 1975), or *contextual*, how salient the content is to the reading task (cf. Hayes, Waterman, & Robinson, 1977; Pichert & Anderson, 1977). It may also result from some specific interest of the reader (e.g., Anderson, Reynolds, Schallert, & Goetz, 1977). Current research, which has emphasized the role of textual importance, has demonstrated a strong *levels effect*, with people remembering information that is prominently placed textually (Johnson, 1970; McKoon, 1977; Meyer, 1975). Even when they do not understand the content and their reading is characterized by "shallow semantics," mature readers are often able to select the textually important content (Kieras, 1982, 1985).

Readers *organize*, as well as select, content as they construct representations of texts. They apparently use a macroprocessing strategy based on knowledge and use of organizational patterns of discourse (Kintsch & Yarbrough, 1982); they approach texts knowing how discourse is conventionally organized and how to use text structures to guide their understandings. When they have no overriding purpose or

perspective and the texts they read are well organized, skilled readers in research studies usually use the same organization as that of the text. They do so in reading stories (e.g., Thorndyke, 1977) and expository texts as well (e.g., Meyer, 1975). Meyer and her colleagues (Meyer, Brandt, & Bluth, 1980) attribute this finding to the reader's ability to use the structure strategy, to "follow the text's superordinate relational structure" and to "search for relationships which can subsume all or large chunks of this information and turn it into a summarized comprehensible whole" (p. 78). If, however, the texts are disorganized, or even scrambled, then skilled readers also demonstrate the ability to supply structure, to make the texts conform to a conventional pattern (e.g., Stein & Nezworksi, 1978; Thorndyke, 1977). There is also evidence that people intentionally restructure a text when they disagree with the message (Meyer & Freedle, 1984).

Although the overall organization helps to supply global coherence to a text and to its mental representation, the reader must *connect* content at local levels as well (i.e., at the level of propositions, clauses, and sentences) in the discourse structure. The text provides some guidance for linking ideas through various kinds of cues, such as logical connectives (Frederiksen, 1975), linguistic cohesion, including anaphoric ties (Halliday & Hasan, 1976), topic-comment patterns (Danes, 1974), and given-new placement of information (Clark & Haviland, 1977). Although readers use the local-level connections supplied in the source, they also generate connections of their own in the form of inferences (Clark, 1977), which become an integral part of the mental representation of the text (Kintsch, 1974). Whereas various types of inferences have been identified (e.g. Seifert, Robertson, & Black, 1985), some types seem more important than others in the reading of certain texts, such as causal inferences in the reading of stories (Kemper, 1982). Since reading is a constructive process and readers make these inferences, the text does not have to be completely explicit in regard to connectivity.

The research thus shows that readers make good use of what the text offers. Yet, even with the same text, people vary in the constructions they make. This variability is quite apparent when researchers compare readers' recalls or summaries, forms of second-order discourse (Kintsch & van Dijk, 1978), with the sources. A number of factors within the reader can affect the nature of the constructions, such as prior knowledge of the topic (e.g., Chiesi, Spilich, & Voss, 1979). People with extensive topic knowledge know what is important to select; they instantiate appropriate organizational patterns for the content and can use their topic knowledge to make connective inferences to fill in gaps. Two other factors that have accounted for important differences among readers in previous research are developmental level, often indexed by grade in school or by age, and verbal ability, most often assessed with a test of reading achievement. Of course, age/grade level and reading ability are not completely distinct from each other. As people mature and progress through school, their reading abilities increase even when their relative positions among their peers, in terms of stanine and percentile scores from reading tests, appear stable.

Developmental patterns in readers' selections emerge in studies of recalling and summarizing. With maturity people develop an awareness of textual importance, and they use that knowledge in making selections. Although McGee's (1982) study of text recall suggests strong developmental contrasts in students' selections between 3rd and 5th grades, research in summarizing by Brown and her colleagues indicate that the years after 7th grade are especially critical for the metacognitive development that is associated with sensitivity to textual importance. At about that time they begin to use their study time to learn the most important content in a text (Brown & Smiley,

1978). And between 7th grade and 10th grade they begin to gain real proficiency in summarizing, moving beyond the simple strategy of deleting trivial and redundant content to use of the more sophisticated summary rules, which include selection of topic sentences (Brown & Day, 1983). Research has also demonstrated patterns in selecting that are associated with reading ability; better readers at various levels of schooling are more adept than less able readers at selecting textually important content for their recalls and summaries (Eamon, 1978; Johns, 1985; McGee, 1982; Meyer, Brandt, & Bluth, 1980; Winograd, 1984).

Like sensitivity to textual importance, use of text organization appears to be associated with age/grade level and reading ability. In contrast to young readers, more mature readers are more likely to use the same organization as that of a well structured source text for their recalls (McGee, 1982); in addition, they are better at imposing organization on a disorganized source text (Stein & Nezworski, 1978). Developmental studies also suggest that older students demonstrate better recognition of text structures (Englert & Hiebert, 1984) and may produce better organized reports of their own (Langer, 1985, 1986). In comparisons based on reading ability, skilled readers make more use of the organization of the source text in recalling discourse than do less skilled readers (McGee, 1982; Meyer, Brandt, & Bluth, 1980; Taylor, 1980). Moreover, they are better at producing and recognizing various structures (Hiebert, Englert, & Brennan, 1983).

Finally, the ability to supply connective links in comprehending discourse has also been associated with both maturity/grade level (e.g., Schmidt & Paris, 1983) and achievement in reading(e.g., Holmes, 1987). Though developmental research has not focused directly on the connectedness of second-order discourse, a growing number of studies shows that, as students mature, their "original" discourse becomes more connected (McCutchen, 1986; McCutchen & Perfetti, 1982; Scinto, 1986). In recalling discourse, better readers supply more connections, tending to produce true connected discourse, while less skilled readers' recalls are more like disconnected lists (Marshall & Glock, 1978-79; Meyer, Brandt, & Bluth, 1980).

Reading to Write

In addition to factors within the reader, such as maturity and reading ability, the nature of the reading task can also affect readers' constructions. Much of our research thus far has emphasized reading to comprehend (to understand, to learn, to remember); the reader's major task in these studies is to acquire knowledge. After reading, the reader may write a recall or a summary, but that production is mainly to demonstrate or to check the knowledge that has been acquired. Of course, in the real world people have other purposes for reading that differ from, or go beyond, knowledge acquisition, and they can vary their reading according to their purposes. A number of studies (e.g., McConkie, Rayner, & Wilson, 1973; Postman & Senders, 1946) demonstrate that people adapt their reading to meet the requirements of different tasks. A relatively new development, though, is the study of tasks that entail *reading to write* (Flower, 1987), tasks in which readers use textual sources to produce their own new texts that have a communicative intent. Instead of being either reading tasks or writing tasks, these tasks are *hybrids*, as Bracewell, Frederiksen, and Frederiksen (1982) explain:

> The task environment . . . reveals how discourse production and discourse comprehension are related. They are not opposites, but rather are processes that may both occur in a task environment. The extent to which a task is regarded as a production or comprehension task depends

> on the specific constraints that are operating and affecting the comprehension and production processes of the language user. Thus discourse tasks constitute a family . . . . Between the extremes of the dimensions, where information constraints are at an intermediate level, lies a range of tasks which we label as hybrid tasks. These tasks have characteristics of both discourse production and discourse comprehension. (p. 55)

The products of these hybrid tasks can be studied in much the same way as the products of reading comprehension (recalls, summaries) to see how people construct meaning. However, since reading to write encompasses acts of composing, attention can also be directed to how people manage the rhetorical task of communicating.

Some hybrid reading-to-write tasks involve *discourse synthesis*, a process in which readers/writers read multiple texts on a topic and synthesize them to create new texts (Spivey, 1984). They *select* content from the composite offered by the sources--content that varies in its intertextual importance because some may be available only in one source and some may be repeated across texts. They *organize* the content, often having to supply a new organizational structure. And they *connect* it by providing links among related ideas that may have been drawn from multiple sources. Synthesis is an act of *comprehending*, in which the reader forms a mental representation from textual cues. Moreover, it is an act of *composing* that results in a new text to be read (or heard), a text that is shaped by rhetorical considerations, such as purpose and audience (Kinneavy, 1971), and that is the product of composing strategies, including planning and revising (Flower & Hayes, 1981; Hayes & Flower, 1980).

How do people of varying ages and reading abilities select, organize, and connect content from sources when they perform a constructive act of discourse synthesis? The reading research reviewed earlier suggests some developmental patterns and reading-ability patterns when people read texts for purposes of comprehension. Are there similar developmental and reading ability patterns in those operations when the task involves reading to write? Though we have no developmental research in discourse synthesis, some studies have begun to look at how students of different reading abilities perform. Spivey (1984) gave university-level juniors and seniors a task that entailed writing an informational text for young adults that incorporated material drawn from three descriptive texts on a single topic. The student's syntheses, like the source texts, had framelike collection structures with clusters of content on subtopics. Proficient readers performed differently from less proficient readers on the task. In selecting content for the syntheses, they not only included more source material but also demonstrated more sensitivity to importance--an intertextual importance determined by the height of a given idea in the hierarchy of a single text and by its repetitions across texts. They organized their compositions differently, providing more compact, integrated collection structures for their texts, though they included more content. Their products, which received higher holistic quality ratings, were also better connected, requiring fewer resource-consuming operations and inferences on the part of readers. A second study (Spivey, 1988) that had college students synthesize informational discourse with a comparison structure for their peers also linked reading ability with characteristics of syntheses, especially organization.

Are differences among readers reflected in how the students approach and manage the synthesizing task? Do better readers expend more effort in synthesizing the material to arrive at their better syntheses? Do they expend less effort? Spivey

(1984) included three surface measures for aspects of task management--plan, revision, and reading-writing time--but found no differences between the two groups on any of the three, perhaps because of the nature of the measures. The measure for planning might have given undue attention to a mechanical aspect of the process, underlining on the source texts, since the scale gave as much weight to marking the sources as to developing a written plan. The measure for revision might not have focused on critical aspects of textual change, since it included all kinds of retranscriptions. As in other studies (e.g., Faigley & Witte, 1981; Sommers, 1980), many of the students' retranscriptions, which were at the word level, did not result in substantive changes in the text. In another study involving multiple sources, Kennedy (1985) did find differences between skilled and less skilled college readers in managing the task of writing an "objective essay." Kennedy focused her research on behaviors, as reflected in think-aloud protocols, of students who were given multiple source texts and were asked to write the essay. Despite the small sample size (six subjects), she found some evidence in the protocols that the fluent readers were more actively engaged with the sources. From the study, though, we do not know if the students developed different kinds of written plans or made different kinds of retranscriptions, since the products were not analyzed, nor do we know if either group spent more time, since the data were reported in terms of episode frequency and not total time.

One would expect to find differences among groups of readers to be reflected in how they manage the task as well as in the kinds of texts produced. To date, though, there is little evidence of how differences associated with reading ability might be manifested in written plans, textual changes, or time devoted to a synthesis task. Nor do we have a strong basis for predicting developmental differences on the three. Although studies in other types of composing indicate links between adult expertise and planning (e.g., Flower & Hayes, 1981) as well as between adult expertise and large-scale textual changes (e.g., Faigley & Witte, 1981), research in writing thus far indicates that for much of their writing many students, even high school seniors and college students, do little whole-text planning and little revising that is substantive (e.g., Butler-Nalin, 1984; Emig, 1971; NAEP, 1977; Pianko, 1979; Sommers, 1980).

Though the three earlier synthesis studies tell us something about how readers/writers synthesize from multiple sources, this research has been limited to the performance of college students. The study reported here extended research in discourse synthesis by investigating the performance of younger students. Our objective was to continue the line of research into variability among readers by examining in a single study differences associated both with grade level and with reading-ability classification at that grade level: (1) to see how developmental differences might manifest themselves across three grade levels during an important five-year period in students' schooling and (2) to see how students of different reading abilities at those grade levels make use of sources to write their own informational texts. The study, based on the constructivist framework described above, focused on textual evidences of selecting, organizing, and connecting, as well as the overall quality of the text. It also incorporated on a heuristic basis three surface measures for aspects of task management: plan, retranscription, and reading-writing time.

Method

Subjects

Participants in the study were 60 students in the 6th, 8th, and 10th grades in a public school district in northern Texas. Of the 20 students from each grade level, 10 were accomplished readers for their grade level and 10 were less accomplished readers, as indicated by their scores on the Reading Comprehension Subtest of the Comprehensive Test of Basic Skills (CTB/McGraw-Hill, 1983). The accomplished group's scores were in the upper three stanines (7th, 8th, 9th), and the less accomplished group's scores were in the middle stanines (4th, 5th, 6th). Group designations were confirmed with students' performance on cloze passages. The subjects came from six English/language arts classes (two at each grade level) that participated in the study. We limited the subjects to students who were present all three days of the study and who completed the assignment, and so we excluded 6 students (2 from grade 6, 1 from grade 8, and 3 from grade 10) who were absent one day or more during the study and one 8th-grade student who did not complete her report. We also screened for topic knowledge. Students from participating classes were tested for prior topic knowledge with a method similar to Langer's (1984) free-association measure, though we modified the procedure by using a single cue, *rodeo*, instead of three. People with extremes of minimal topic knowledge (2 students) or extensive, highly organized knowledge (3 students) were not included. We used a random selection process to select the 60 subjects from pools stratified by gender as well as reading ability and grade level so that the groups would be balanced in numbers of males and females.

Materials

The source texts on the topic "rodeo" were three descriptive texts selected from reference sources intended for use in the middle school years: *Britannica Junior Encyclopaedia* (Encyclopaedia Britannica, 1981), *World Book Encyclopedia* (World Book, 1986), and *The New Book of Knowledge* (Grolier, 1985). Word count was 453, 931, and 1226, respectively. All three informational texts were organized with a collection top-level structure (Meyer, 1985) that had information clusters on such themes as rodeo events, rodeo sponsors, and participants' skills. As shown in Table 1, within the three textual sources was a composite of content with some repetition across texts. Although some units of the content appeared in only one text, others appeared in two, and some in all three. For instance, all three texts tell the reader that there is a Rodeo Cowboys Association, two say that the association makes rules for rodeo events, and one mentions that stock contractors are members of the association. Following Spivey (1984), content units of informative facts were derived from a parsing procedure based on Turner and Greene's (1978) formalization of Kintsch's (1974) propositional analysis.

	Brit. Jr.	World Book	New Book of K.
Content units in this text only	71	105	124
Content units in this text and one another	26	59	52
Content units in this text and both of the others	16	16	16
Total	113	180	192

Table 1. Content Units Available in Source Texts

Procedures for Data Collection

Report-writing took place over 3 consecutive days in the students' language arts/English classes. On the first day at the beginning of the 50-minute class period, students wrote down ideas and information associated with the word *rodeo*. After these lists were collected for the prior knowledge measure, the students received their assignments, the three source texts, paper for their drafts, and "scratch" paper. At the time of the study, Texas was celebrating its Sesquicentennial, and numerous activities in the schools were focused on "Texana." The writing task, contextualized into these activities celebrating Texas events and traditions, asked students to write a report to inform people about the rodeo. The audience was adults and teenagers in their community who were new to Texas and who did not know much about the rodeo. In preparing the report, the students had the three encyclopedia articles from which to draw content, though they were to put the information in their own words.

That first day, students worked independently on the task throughout the remainder of the class period. During the next 2 days in class, they continued writing their reports, using materials from the first day, and completed a final version by the end of class the third day. All products--scratch paper, planning pages, false starts, drafts, source texts--were collected for analysis, and records were kept of the amount of time spent each day and the total time that each student devoted to the report.

Measures

The major dependent variables included four measures for features of the final composition--quantity, organization, connectivity, and holistic quality--and three measures for task management--plan, retranscription, and reading-writing time. Interrater reliabilities for quantity, holistic quality, and connectivity were based on independent raters' scores for all 60 reports, two raters' scores for quantity and three raters' scores for holistic quality and connectivity. Reliabilities for organization, plan, and retranscription were based on subsets of 20 reports selected at random and scored by two independent raters who divided up scoring of the other 40 in the set.

Quantity. Quantity of content was the number of content units used by the student in the final version of the synthesis text. This number included units that were drawn from the sources and that were added, as determined by scoring the report against a composite template of units available in the three source texts. Reliability for scoring was .95 (Pearson's r). The template identified which units were available in one source, in two, or in all three (see Table 1).

Organization. Organization was measured with a breadth/depth ratio of number of thematic chunks to number of content units included (Spivey, 1984). Ratio of breadth to depth (cf. Collins & Gentner, 1980; Nold & Davis, 1980; Vipond, 1980) is a way to quantify organization for descriptive texts, which tend not to have a canonical order for content in their collection structures. For this analysis of organization, content units from the synthesis text were tagged for themes, including location (L), popularity (P), history (H), rodeo associations (A), sponsors (Q), events (E), skills (S), all-girl rodeos (W), rodeo stock (M), other entertainment (O), and general information (G). For the analysis of organization, a vertical chain of thematic tags, as illustrated in Figure 1a, was formed from the content units included in the synthesis. And, as illustrated in Figure 1b, when there was no overlapping content and when the writer did not supply a link, the content was considered to be two separate chunks; but, if the writer did supply a link, the two so connected were considered to be one thematic chunk. For counting chunks in a text, interrater reliability was .84 (Pearson's r). The organization measure was number of thematic chunks divided by number of content units.

Connectivity. Connectivity was also assessed with a ratio, in this case, number of perceived connective operations to number of content units included (Spivey, 1984). Three raters read all the compositions and marked them for occurrences of 14 different kinds of problems requiring connective inferences by the reader, such as searching for an antecedent, adding a referent, and resolving an ambiguity or contradiction. A reliability of .91 (Cronbach's α) was calculated for total problems counted per text. The measure used in analyses was the average number of problems in a text divided by the number of content units included in the text.

Holistic quality. The reports were judged for overall quality by three raters who read typed versions and gave each report a rating from 1 (low) to 6 (high). The teachers who served as holistic raters did not perform any of the other, more analytic ratings. The scoring system they used was a form of general impression marking that is commonly used in writing assignments (see Cooper, 1977), in which each rater gives one score for quality relative to the whole sample. The raters were trained in general impression scoring with practice papers (written by students not included in the study) representing the range of quality for the sample. Though the holistic raters were instructed to use the six-point scale, no predetermined set of criteria was given them. The holistic rating we used in the study was the summed general impression score, combining the three ratings, for which reliability was .89 (Cronbach's α).

Plan. Planning, as evidenced in written plans and markings, was measured with a four-level scale: 0, no written plan of any type and no marking on the source material; 1, sketchy written plan, underlining on the source texts, or both; 2, moderately elaborate written plan accompanied or not accompanied by underlining on the source texts; 3, elaborate written plan accompanied or not accompanied by underlining on the source texts. The measure, for which reliability was .97 (Pearson's r), contrasts with the one used in Spivey (1984), which gave equal weight to markings on the source texts and to development of the written plan.

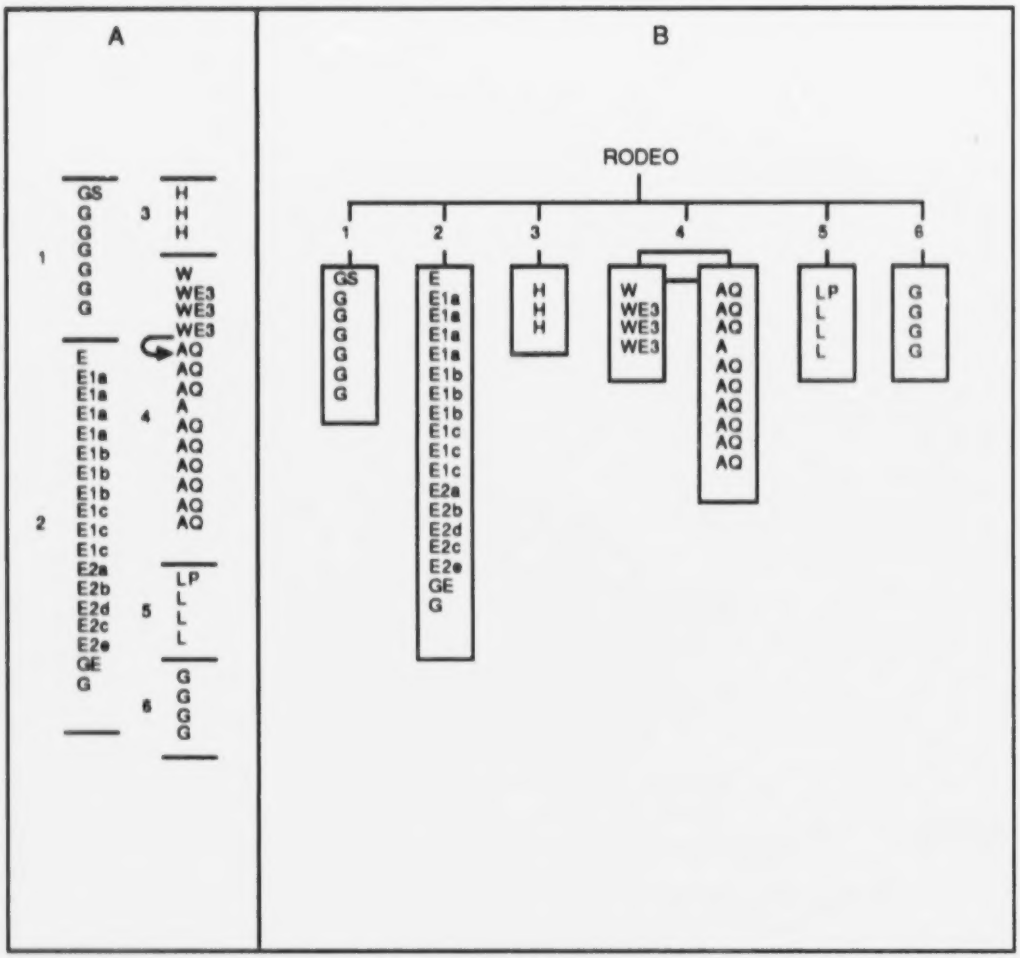
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Figure 1. Thematic chaining (A) and thematic chunking (B) in a sample student text

Retranscription. Instead of counting all changes made in the text, as Spivey (1984) did, we based the revision measure only on changes within and across drafts that affected more than a single independent clause with all its dependent clauses and modifiers (a T-unit, Hunt, 1965). This decision was based on research suggesting no strong connections between writing quality and word-level retranscriptions typically made by student writers (e.g., Perl, 1979; Sommers, 1980; Spivey, 1984). The changes we counted, with an interrater reliability of .76 (Pearson's r) for total counts per report, included additions of independent clauses as well as changes in ordering and in overall organization. The measure in the data analysis was the ratio of these changes to number of content units.

Time. Time was the number of minutes students spent on the task over the three-day period. Since all students were working on the task the first 2 days in class, the differences came on the third day, as they turned in their materials upon completing the task.

Results

Differences in Use of Sources

Three separate analyses of variance (ANOVAs) compared the students in their selections of content from the textual sources. In these analyses as in other analyses in the study, square root transformations were used for data that were proportions. However, in Tables 2 and 5 and in Figure 2 untransformed data are provided for ease of interpretation. The first ANOVA was designed to see if students differed by grade or group in selecting intertextually important content. Intertextual importance was defined simply by repetition across the three texts: least important, 1, was information unique to single texts; medium important, 2, was information present in two; and most important, 3, was information in all three. This analysis had two between-subjects factors, grade level and reading-ability group, and one within-subjects factor, importance of content; the dependent measure was the proportion included of the content available for each importance level. Tests of significance found main effects for grade, $F(2, 54) = 3.80$, $p < .05$, and for group, $F(1, 54) = 13.76$, $p < .001$, but no significant effect for the interaction between grade and group, $F(2, 54) = .17$. The older students included more content from the source than the younger students did, and the better readers included more source content than the less proficient readers did. However, of major interest were results of the tests of significance involving importance: a main effect for importance, $F(2, 53) = 119.23$, $p < .0001$, and interactions between grade level and importance, $F(4,106) = 2.85$, $p < .05$, and between reading ability group and importance, $F(2, 53) = 3.49$, $p < .05$. Although both groups and all grades included larger proportions of intertextually important content than of content appearing in only one source, the older students and better readers were more likely to include the content that was most important intertextually. Figure 2 illustrates these linear patterns for grades and groups. The three-way interaction was not significant, $F(4, 106) = 1.14$.

The other two planned ANOVAs also compared the grades and groups for their selections of content from textual sources. A comparison based on the ratio of source content to total content included in the report resulted in a significant effect for reading ability group, $F(1, 54) = 7.85$, $p < .01$, though not for grade, $F(2, 54) = .66$. Whereas the less accomplished readers had larger proportions of "original" content, the accomplished readers had larger proportions of source content. Table 2 shows a breakdown by group within grade for proportions of source content and suggests why the interaction between group and grade approached significance, $F(2, 54) = 2.98$, $p < .06$. The other test was intended to show if there were differences in degree of reliance on a single textual source. The dependent measure in this ANOVA was the largest proportion of unique information drawn from a single source of all the unique source information that was included. This analysis revealed no significant effects for grade, $F(2, 54) = .28$, or group, $F(1, 54) = .02$, or interaction between grade and group, $F(2, 54) = 1.92$, in degree of reliance on a single source. The source most used for unique content was the *World Book*, which contained less unique content than *The New Book of Knowledge* but more than *Britannica Junior* (see Table 1).

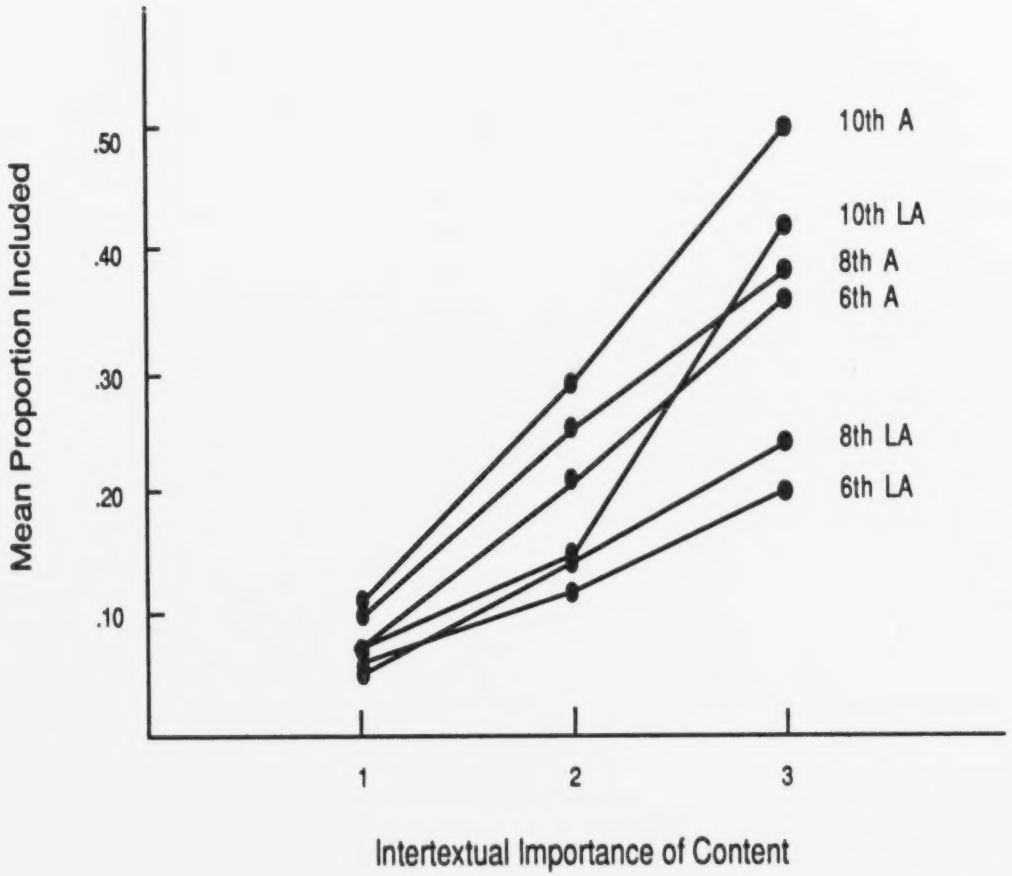

Figure 2. Grade-level and reading-ability patterns in students' selection of content from three levels of importance in the composite source material

Groups	Grades			
	6th	8th	10th	All
Accomplished Readers	.78	.86	.86	.83
	(.15)	(.10)	(.12)	(.13)
Less Accomplished Readers	.80	.62	.69	.70
	(.11)	(.26)	(.21)	(.21)

Table 2. Means and Standard Deviations for Ratios of Source Units to Total Content Units in Syntheses

Differences on Text and Task Measures

Multivariate analyses of variance (MANOVAs) tested for overall differences among grades and between groups and for interactions between the two factors on text measures and task management measures. Following Stevens' (1986) suggestions, we used two MANOVAs, one for those measures for which we had a strong empirical and/or theoretical basis and one for those measures that we were testing on a heuristic basis. The first MANOVA included measures for total quantity of content as well as organization, connectivity, and holistic quality of the texts, and the second included the task management measures for reading-writing time and for surface evidences of planning and revision.

Table 3, an intercorrelation matrix, shows correlations among these dependent measures. Correlations are apparent among all measures for the textual product, which include quantity, organization, connectivity, and holistic quality, and between the task measures for plan and reading-writing time. In addition, other correlations are among some measures from the text set and the task set: quantity with plan and time, organization with plan, connectivity with time, and holistic quality with plan and with time. Worth noting here is the lack of significant correlations between retranscription and any of the other measures. Students made very few large-scale changes in their reports, and there was little variability in the ratio of textual changes to content units.

	1	2	3	4	5	6	7
Text Measures							
1 Quantity		-.61***	-.43***	.79***	.36**	.05	.45***
2 Organization[a]			.43***	-.65***	-.27*	-.07	-.24
3 Connectivity[a]				-.52***	-.16	-.13	-.32*
4 Holistic Quality					.39**	.10	.50***
Task Management Measures							
5 Plan						-.12	.36**
6 Retranscription							.17
7 Time							

Note. N = 60.

[a]Because smaller numbers for these measures reflect tighter organization and clearer connectivity, respectively, negative correlations with them suggest positive relationships with the constructs they represent, except in the case of the intercorrelation between the two.

*p<.05 **p<.01 ***p<.001

Table 3. Intercorrelations among Discourse Synthesis Variables

The first MANOVA with the text measures resulted in significant effects for both grade, $F(8, 102) = 2.07$, $p < .05$, and group, $F(4, 51) = 8.92$, $p < .0001$, though not for the interaction, $F(8, 102) = .56$. The follow-up univariate F-tests, summarized in Table 4, indicated differences among the three grade levels in quantity, connectivity, and holistic quality. Tests of least square differences revealed that the 6th graders differed from the 10th graders in quantity and holistic quality and differed in connectivity from both the 8th and 10th graders, who did not differ significantly from each other. The older students' reports were more elaborate in content, were better connected, and were rated higher for holistic quality than the 6th graders'. The univariate tests for the reading-ability factor indicated significant differences between accomplished and less accomplished readers on all four measures: quantity, organization, connectivity, and holistic quality. The accomplished readers' reports were more elaborate, were more tightly organized, were better connected, and were rated higher for holistic quality than the less accomplished readers'.

On the MANOVA for the measures being tested on a heuristic basis, there was a main effect for group, $F(3, 52) = 6.40$, $p < .001$, but not for grade, $F(6, 104) = .50$, and there was not a significant effect for the interaction between group and grade, $F(6, 104) = .56$. Univariate F-tests following the significant overall effect for group, which are also reported in Table 4, indicated differences between the accomplished and less accomplished readers on both plan and time. The better readers produced more elaborate written plans and spent more time on the task. Table 5 shows means and standard deviations for groups and grades on all seven dependent measures.

	F for Grade[a]	F for Group[b]
Text Measures		
Quantity	3.59*	14.38***
Organization	2.09	12.15***
Connectivity	7.33**	6.94*
Holistic Quality	3.41*	36.87****
Task Management Measures		
Plan	.06	13.64***
Retranscription	1.11	.01
Time	.18	11.20***

[a]df = 2, 54 [b]df = 1, 54

*p<.05 **p<.01 ***p<.001 ****p<.0001

Table 4. Univariate F-tests for Group and Grade Following MANOVA for Text Measures and MANOVA for Task Management Measures

	Grades										
	6th			8th			10th			All	
	All	A	LA	All	A	LA	All	A	LA	A	LA
Quantity	43.95	52.50	35.40	55.25	63.00	47.50	59.10	70.10	48.10	61.86	43.67
	(17.94)	(19.92)	(10.96)	(20.02)	(22.79)	(13.91)	(22.95)	(20.44)	(20.62)	(21.63)	(16.27)
Organization[a]	.13	.11	.16	.10	.08	.12	.10	.08	.13	.09	.14
	(.06)	(.05)	(.06)	(.07)	(.04)	(.08)	(.06)	(.05)	(.06)	(.05)	(.06)
Connectivity[b]	.25	.25	.25	.16	.13	.18	.14	.10	.19	.16	.21
	(.17)	(.23)	(.08)	(.07)	(.05)	(.09)	(.07)	(.04)	(.06)	(.15)	(.08)
Holistic Quality	9.20	12.00	6.40	11.55	14.20	8.90	11.65	14.10	9.20	13.43	8.17
	(4.53)	(4.16)	(2.91)	(4.15)	(2.70)	(3.67)	(4.04)	(2.68)	(3.74)	(3.31)	(3.57)
Plan	.75	1.40	.10	.80	1.20	.40	.85	1.10	.60	1.23	.37
	(1.07)	(1.17)	(.32)	(1.01)	(1.13)	(.70)	(.93)	(.88)	(.97)	(1.04)	(.72)
Retranscription	.02	.02	.02	.04	.04	.03	.03	.03	.03	.03	.03
	(.03)	(.03)	(.03)	(.03)	(.03)	(.04)	(.04)	(.04)	(.04)	(.03)	(.04)
Time	95.25	101.80	89.70	94.15	101.30	87.00	97.45	107.60	87.30	103.23	88.00
	(19.42)	(19.48)	(18.67)	(14.39)	(12.04)	(13.38)	(22.22)	(8.95)	(27.08)	(14.05)	(19.82)

Note. n = 20 for each grade, 10 for each group within each grade. A = accomplished readers, L = less accomplished readers.

[a]This variable, thematic chunks/content units, is inversely related to the construct it is intended to represent. A smaller number represents a more tightly organized text.

[b]This variable, connective operations/content units, is inversely related to the construct it is intended to represent. A smaller number represents a better connected text.

Table 5. Means and Standard Deviations of Discourse Synthesis Variables for Grades and Groups

We also used discriminant analyses to see how well overall performance on the synthesis task coincided with grade level and reading ability classification. With all seven variables in the analyses 58 per cent of the students were correctly classified into their grades, but 83 per cent were correctly classified into their original groups as accomplished or less accomplished readers. The measures did better for predicting reading ability classification than they did for predicting grade level classification.

Discussion

In this study of discourse synthesis, we examined students' performance on a report-writing task that involved drawing content from source texts. Though we found reading-ability differences as well as grade level differences in the overall quality of the reports, we were most interested in how students of different reading abilities from three grade levels might vary in using the sources and composing the reports. Developmental patterns emerged in students' selecting and connecting of content, whereas reading-ability patterns were apparent in organizing as well as selecting and connecting of content. Reading-ability differences were also reflected in extensiveness of written plans and in time spent on the task.

Developmental Patterns

One strong finding in our study was a developmental difference in selecting content from the sources. Not only did the older students produce texts with more content, but they were also more likely to include the most important information, with *important* defined in the study in terms of repetition across texts. Though students in all grades tended to include larger proportions of intertextually important information (a *levels effect*), we found gains to be most obvious between the 8th and 10th grades, at about the same age as Brown and Day's (1983) findings for special gains in metacognitive development relative to summarizing. Our 10th graders appeared to be more sensitive to intertextual importance than the younger students were, since they were more likely to include content that was present in all three sources. When we asked them after they wrote how they decided what to include, several mentioned using an intertextual criterion. For instance, one student said, "If something is repeated in several articles, then it's obvious that it's important." There is a possibility, though, that some of the older students were better able to select what was important in the content domain without using intertextual cues. The content repeated across texts tended also to be key information about the event structure of the rodeo.

Another strong developmental finding in our study was the grade-level effect for increases in connectedness of discourse. The 6th graders' prose often had gaps, as the following excerpt from one report demonstrates. To form a coherent representation for this text, the reader has to expend great cognitive effort by filling in the gaps and by finding or generating referents for words:

> The cowboy that is riding the bull or horse must hold the rope with one hand. If they hold it with two, they will have some seconds taken off. Some cowgirls have the color and spirit of the Old West. Cowboys and cowgirls ride on their horses, and they sometimes rope up cows. But we all know that most of the people come for the cheering up. That is why they use clowns. The clowns help the cowboys and cowgirls if they fall off the bull or horse. Clowns sometimes get in the barrel to protect himself from the bull or horse . . . .

The developmental literature describes certain kinds of knowledge that people gain as they mature, knowledge that helps them provide connections in their discourse. Important, of course, is students' ability to make explicit the connections that they see, to apply linguistic knowledge that includes the use of various kinds of referential and logical connectives. McCutchen (1986) interpreted developmental differences among her students as showing that the older students "can use relational links among concepts in the knowledge base to build coherence links in the discourse and . . . can control the linguistic constructions that express those various conceptual and discourse relations" (p. 442). Another kind of knowledge that the older students may have been applying on this task is rhetorical knowledge, an awareness of the needs of the audience. A number of studies have shown that, as people mature, they develop the ability to adapt a given text for a particular audience (e.g., Kroll, 1985). Some researchers explain this ability to adapt to audience in terms of *social cognition*: a person's "intuitive or logical representation of others" (Shantz, 1975, p. 257), her characterization of others' mental states and cognitive processes. Social cognition includes recognizing that readers' representations may be different from writers' and anticipating how language and structure may affect readers' understanding of the text (Rubin, 1984).

Performance of Accomplished and Less Accomplished Readers

From our results, it appears that general reading ability and success in synthesizing overlap to a great extent--reading ability and performance on this synthesis task resulting in the same classifications for 83 per cent of the cases in our study. On these gross classification measures, reading ability was more closely related to synthesis performance than grade level was. Certainly, while progressing through school, students were developing some overall proficiency, as reflected in the holistic scores, and they were developing some specific abilities in selecting content and providing connectivity. Yet there were strong commonalities among accomplished readers across the grades and commonalities among the less accomplished readers across the grades. What do better readers do in synthesizing that makes their textual products superior? What do they do that less proficient readers do not do?

On this kind of task they apparently make more use of the sources. Whereas students generally made strong use of the source material, averaging 75 per cent of the total content in their reports, the better readers selected larger proportions of source material than the less skilled readers did, and included more source information across the three levels of intertextual importance. Reading ability, like grade level, interacted with importance. As in Spivey's (1984) study comparing groups of readers, as the information became more important intertextually, the accomplished readers were more likely than the less accomplished readers to include it.

The two groups of readers also performed differently in connecting and organizing the content they selected, as in Spivey's (1984) study. The better readers produced texts with more local coherence, as evidenced in clearer connections for the reader, and also superior global coherence, as evidenced in tighter text organization. The differences in organization are especially interesting. The accomplished readers were not only dealing with more content but also with larger chunks of content, since their texts (which received higher quality ratings) had more integrated structures with more elaborated topics. This ability to organize, or chunk, semantic content appears to be an important link between reading ability and writing ability. On the synthesis task, which involved framing a new text instead of merely reproducing the structure

of a text they had read, the better readers displayed a strong ability to organize discourse (cf. Hiebert, Englert, & Brennan, 1983). Their integrated, well-developed structures contrasted with the less accomplished readers' structures, which were broader and more sparse in content (cf. Vipond, 1980).

Differences in the ability to organize discourse into chunks did not appear to be associated with grade level. Although the older students wrote papers with more content, the ratio of thematic chunks to content units remained relatively stable across the grades (averaging 5.5 chunks to 50 content units). A study conducted recently by Langer (1985, 1986) also examined reports written by students at different grade levels, though the report-writing task she studied was quite different from ours. The 3rd-grade, 6th-grade, and 9th-grade students in that study wrote reports that were "original" discourse (not drawn from source texts, as in our study) on self-selected topics (not all on the same topic, as in our study). Her report prompt was: "Think of something you know a lot about. It can be something you studied in school, a hobby, or something you're just interested in. Write a report about that topic for someone your age to read" (Langer, 1985, p. 160). She had students write stories as well. When she tested for grade-level differences on measures of internal structure for writing in both genres, she too failed to find a significant effect (at $p < .05$) for grade-level. She did, however, find an interaction between genre and grade level, with more change in the structure of reports than stories as grade level increased. Though both her research and ours are developmental studies of report-writing that examine text organization, important differences in these studies make it difficult to relate or contrast our findings. Not only did the studies focus on different kinds of report-writing tasks, but we had a narrower grade span, 6th to 10th in contrast to hers of 3rd to 9th. In addition, the measures for organization were quite different. We used a single measure that looked at breadth in relation to depth, whereas she used a combination of four measures for various aspects of structure: deepest node, broadest node, number of deeply linked nodes, and number of shallowly linked nodes. In our study, although students of contrasting reading abilities across the grades chunked content differently, we did not find a developmental pattern. The younger students appeared to have about as much control of the overall structure of their reports as the older students did (cf. Durst, 1984). This finding is supported by research indicating that many 6th graders are aware of text structures, including collection, and exhibit competence with collection structures in both comprehension and production (Englert & Hiebert, 1984; Richgels, McGee, Lomax, & Sheard, 1987). Figure 3 is a sketch drawn by one of our 6th graders, probably as a planning device, that suggests the clarity of his representation of the genre he was producing.

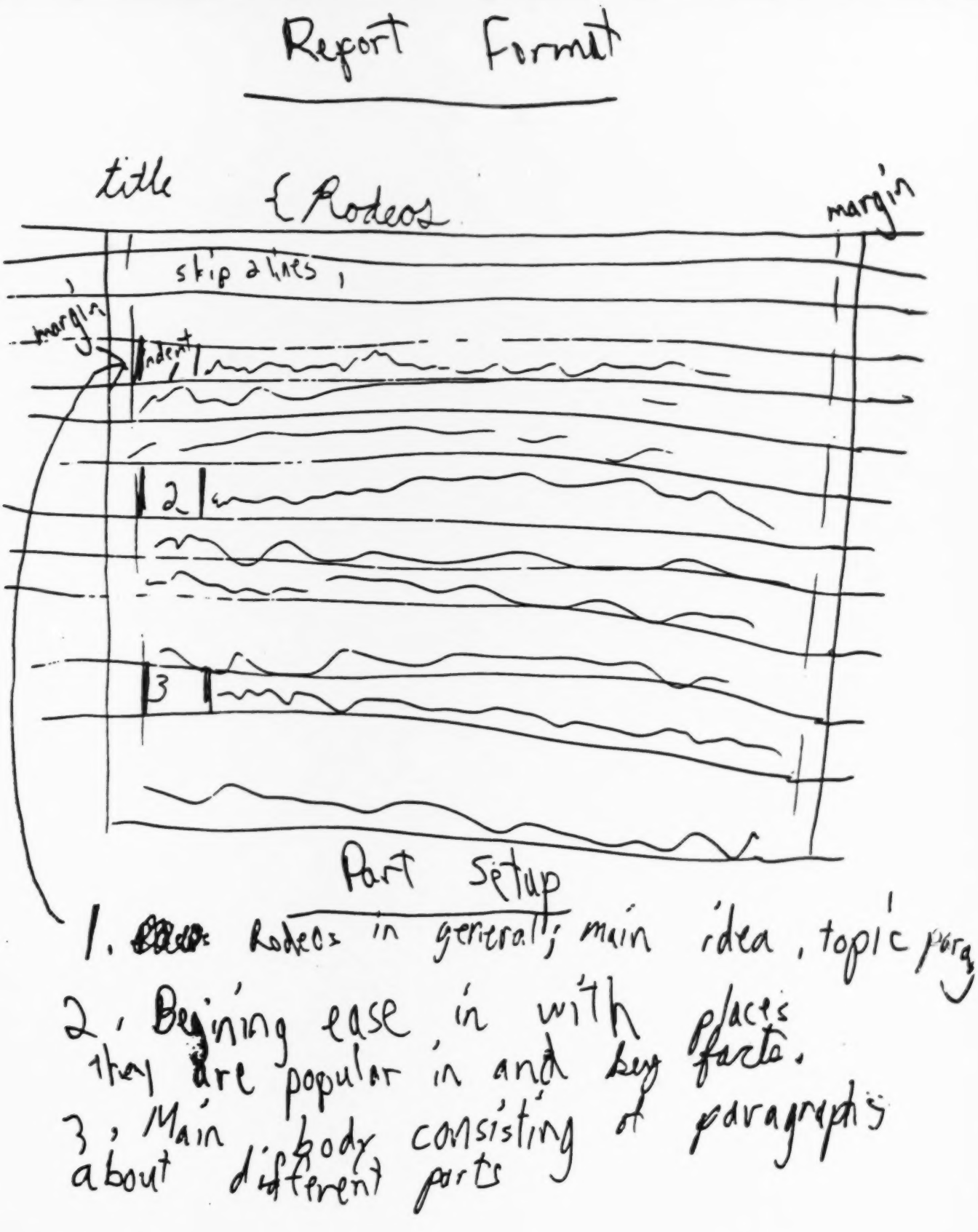

Figure 3. Sixth-grade student's representation of report genre.

Our findings suggest that differences between accomplished and less accomplished readers may be due to effort expended on the task as well as to cognitive factors commonly associated with comprehension, such as sensitivity to structure. The better readers were making more elaborate plans and were spending more time; they were apparently setting a different kind of task for themselves, as did the better readers in Kennedy's (1985) study. This work and some previous research (e.g., Wiens, 1983) lends support to Kennedy's contention that less skilled readers may be more passive in their interactions with texts. This may help to explain the smaller proportions of source material in their reports. For our synthesis task, time devoted to the task and extent of the written plan were both related to the quality of the report. In research on summarizing, Brown, Day, and Jones (1983) found planning to be an important contributor to success in performing their task.

Since our measure for planning was based on the written artifact, the study can only suggest but not really explore the dynamic process of planning--the process of generating and selecting content, structuring it, and setting goals that is often studied through think-aloud procedures (Flower & Hayes, 1981; Hayes & Flower, 1980). Nevertheless, some of the operations of generating/selecting and structuring were apparent even in these written plans. Some evidences of selecting appeared on the source texts in students' markings of selected content and as notes on their planning pages. As illustrated in Figures 4, 5, and 6, evidences of organizing appeared in their clustering, ordering, and numbering on the planning pages. Fifteen of the students (1 out of 4) produced moderately elaborate to quite elaborate written plans, preliminary structures often in graphical form.

Like our measure for planning, our measure for revision was based on the written artifact. But, unlike the scale for planning, our measure for extensiveness of textual change was not statistically related to the quality of the text. Nor was it related to other measures for the product or the process. In an attempt to exclude low-level, "tidying-up" kinds of revisions, we based our measure only on large-scale changes in the texts. What we found was that students did not make many of these changes, such as adding another sentence or moving a chunk of content; they averaged only 1.5 per report. Thus, our study helps to extend to synthesis research the findings cited earlier that secondary students do not seem to do much large-scale retranscription in their composing. We cannot, though, conclude that students were not doing much *revising*, since they may have been making changes in the mental representation that were not reflected in textual changes (cf. Flower, Hayes, Carey, Schriver, & Stratman, 1986; Witte, 1985, 1987).

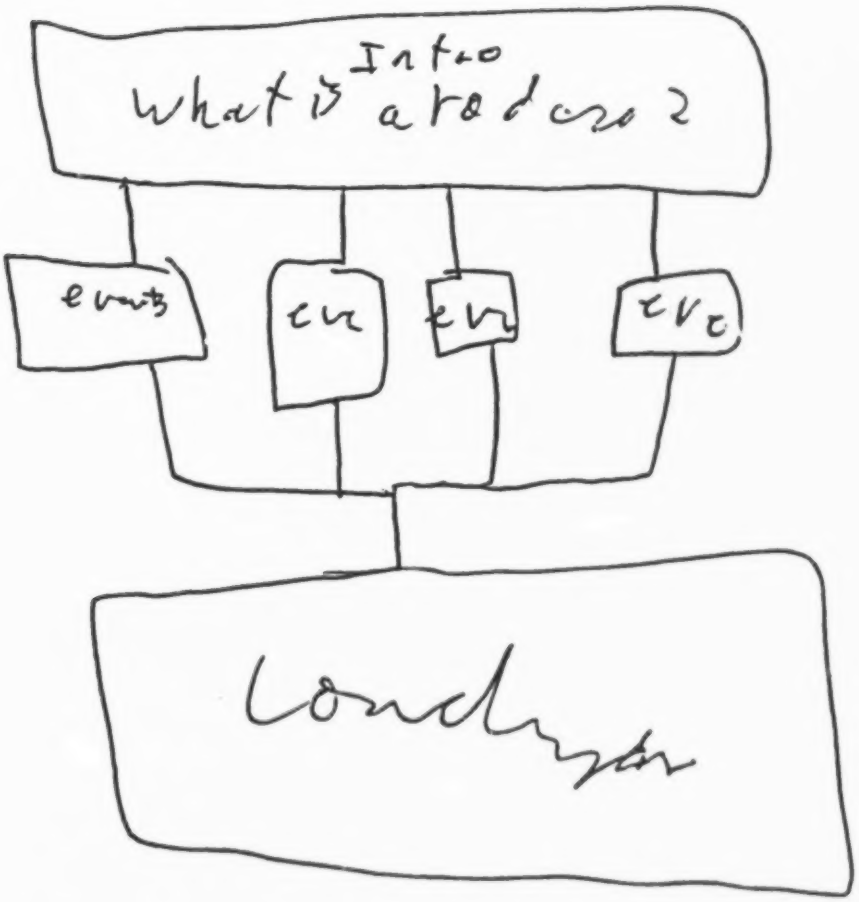

Figure 4. Structure in a student's written plan

Events: saddle bronc riding, bareback bronc riding, bull riding, calf roping, steer wrestling, team roping, barrel racing, steer roping

X
bareback bronc
- mounted 8 seconds
✓ spurring horse
✓ one handed
✓ holds onto bareback rigging device made of leather circled to horse's back like saddle

X
saddle bronc
✓ same to bareback
uses saddle, halter rein
✓ one-handed
✓ 8 or 10 sec.

X
bull riding
✓ stay 8 sec.
✓ holds onto un-knotted rope loop around bull
✓ one hand

X
calf roping
✓ chases calf
✓ ropes it & dismounts
✓ horse backs up so rope is tight
✓ person ties three legs together

X
steer wrestling
✓ also bulldogging
- can have helper
✓ helper keeps animal running straight
✓ cowboy jumps onto steer's back
✓ grabs horns
✓ wrestles to ground

X
team roping
✓ two people work together
✓ one ropes horns
other ropes hind legs
✓ done when both have rope tight at 90° angle from steer

X
steer roping
✓ ropes running steer around horns from one side
✓ changes sides
✓ trips steer
✓ ties animal's hind legs together

X
barrel racing
✓ women
✓ runs cloverleaf pattern
- 3 barrels
✓ adds 5 seconds for each barrel knocked down

All girl rodeos
barrel racing, team + calf roping (called tie-down roping)

X
break-away roping
✓ rope tied to saddlehorn
✓ ribbon on string
✓ rider ropes calf
✓ stops horse
✓ calf breaks tie

X
goat tying
✓ goat tied to stake
✓ rope goat to ground
✓ ties three legs together

steer undecorating
- chase steer with ribbon on back
- must get ribbon
- helper used

Figure 5. Clustering of content in a student's written plan

Rodeos

7
There are alot of rodeos for

girls
womens
boys
men
juniors

6
Most rodeo have 5 timed
events and three rough
events.

2
In 1936 Cowboys formed the
first professional rodeo.

4
In a rodeo their is

bucking Events
Steer wrestling
and much more
Bareback
bronco
riding
bull rieling
Calf Roping Team Roping Barrel Racing and more

(8) Rodeos are done just for
entertainment

In Rodeos ~~need~~ people need skill to ride. #1

Their are two MAIN group they are
timed events + ~~ro~~ rough stock events #5

Rodeo is a popular Sport in Texas and is 3
important also In a rodeo Different skills are required
~~like to~~ like concentrating on the event.

Figure 6. Numbering and ordering in a student's written plan

Conclusion

In conclusion, we would like to consider some of the parameters of synthesis research, which is in its initial stages. Indeed, all sorts of questions about discourse synthesis are unanswered (e.g., specific cognitive abilities involved, performance of other groups of readers/writers, and role of topic and domain knowledge). Research designed to answer such questions must also consider variability within synthesis tasks, which involve performing the complex operations associated with reading (selecting, organizing, connecting) in a rhetorical act of discourse production. We must consider the factors of aim, structure, importance principle, information source, and audience.

In the study reported here and in two other studies (Spivey, 1984, 1988), the assignment given the students cued both an aim and a structure for the discourse. In this study and in Spivey (1984), the students were asked to write to inform, the task implying a collection structure with clusters of content and a relevance principle based on intertextual importance, or repetition across texts. In Spivey (1988) the assignment again was to inform, but it clearly signaled an importance principle based on relevance to similarities/differences. The task constrained, or limited, what was considered relevant for inclusion (cf. McKeown, 1985). In all three studies, the participants, who were not encouraged to present their own ideas, tended to rely on information from the sources. And in all three, students wrote for a fairly mature audience that was not particularly knowledgeable about the topic.

Efforts to explore other aims in synthesis, such as writing to present an original argument (Geisler, in press), produce different kinds of results in structure, importance principle, and source of information. Also, in situations when the task is more open, that is, the constraints are not cued by the assignment, as in many academic tasks, one would expect to find more variability in processes and products (Ackerman, in preparation; Flower, 1987; Kennedy, 1985). Synthesis research, as well as other research into literacy activities, must attend to important task factors as well as cognitive factors.

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